The bilingual Stroop effect between Japanese and Chinese caused by auditory words in both languages

Guan GONG, Qiuyu LIN, and Hiroyuki SHIMADA
Kobe University, 5-1-1, Hukae-minami, Higashinada, Kobe, Japan

Abstract

Japanese and Chinese share almost common ideographic writing (Kanji). We carried out the experiments of the bilingual Stroop effect using complete common color-words (white, black, green and purple) between Japanese and Chinese concurrently with auditory stimuli of color words. We had two conditions controlled by two stimulus onset asynchronies (SOAs) between color-words and auditory stimuli; one condition included that color-words preceded auditory stimuli at 100 ms and the other condition included that auditory stimuli preceded color-words at 100 msec. Presentations of auditory stimuli in either Japanese or Chinese are assumed to make activation of memory on each language. Participants were bilingual students from China. Consequently, we obtained the evidence of stronger interference in vocal response in foreign language to incongruent color-words. It is suggested that the pass way from the native language (Chinese) to the foreign language (Japanese) be more accessible than the opposite direction.

Method

Subjects

Subjects were three Chinese international students at Kobe University. There were two men and one woman who stayed in Japan for three years or more. And, it was self-declared that there was no problem in the color vision in daily life.

Apparatus

The operation of experimental apparatus, the monitor of experiment and the data collection of reaction time were done by a PC. E-Prime (Psychology Software Tools, Inc.） was used as a computer program.

Experimental conditions

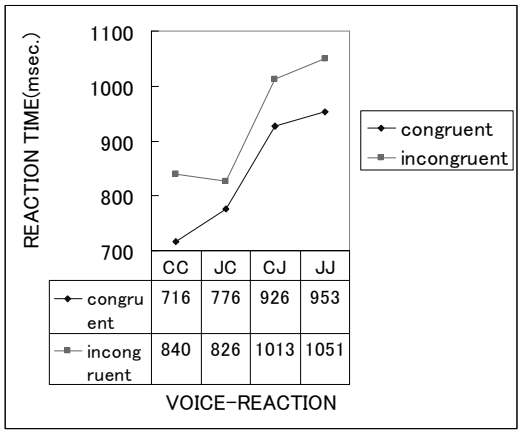
As Japanese and Chinese share almost common ideographic writing (Kanji), four kinds of color words (white, black, green, and purple) were prepared. These four kinds of color words are completely shared with use of both Japanese and Chinese ideographic writing. In contrast with four common written words, four kinds of auditory words (pronunciation of words) were also prepared (white, black, green, and purple) which were different in each language.
They were stored into PC in a way of digital encoding through pronunciation of the Chinese bilingual woman in Japanese and Chinese before the experiment runs.

Stimuli and procedure

The participants had to make vocal responses through color naming of Stroop stimuli in 192 trials in one block. The experiments consisted of four blocks; i.e., 768 trials. The Stroop stimuli consisted of congruent and incongruent color-words in equal frequency. The vocal stimuli consisted of either Chinese or Japanese language in equal frequency. They were semantically consistent with word dimension of Stroop stimuli at all time. Participants had to make aural responses in either Chinese or Japanese between blocks. Stimulus onset asynchronies (SOAs; -100 ms and +100 ms) between vocal and color-words stimuli were varied between blocks of trials.

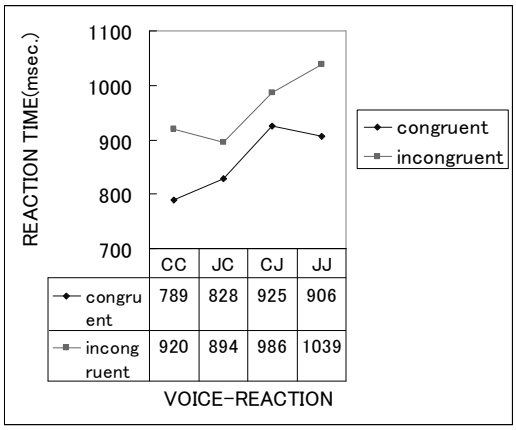
Results and discussion

The reaction time is defined as time that it takes from onset of the color words to onset of subject's vocal reaction. Analysis of variance (ANOVA) with four within-subjects (repeated) factors revealed four main significant effects; main effect A (F= 1109.28, p<.001), main effect B (F= 19.88, p<.001), main effect C (F= 34.53, p<.001) and main effect D (F= 91.22, p<.001). Main effect A is involved in subjects, main effect B is invloved in SOAs between auditory and visual words, main effect C is involved in the kind of languages in vocal responses (between Japanese and chinese), and main effect D is involved in congruency of color-words (congruent or incongruent). We obtained four significant interaction effects; A x B (F= 23.38, p<.001), A x C (F= 10.20, p<.001), B x C (F=27.08, p<.001), C x D (F= 3.01, p<.001). We did not get significant interactive effects in the remain factors; A x D (F= 10.20, n. s.), B x D (F= 1.17, n. s.), A x B x D (F=0.61, n. s.), A x C x D (F= 1.24, n. s.), B x C x D (F= 1.41, n. s.), and A x B x C x D (F= 0.68, n. s.).



	CC	JC	CJ	JJ
congruent	716	776	926	953
incongruent	840	826	1013	1051

Fig 1 Auditory stimuli preceded visual ones in 100 ms (-100 ms)



	CC	JC	CJ	JJ
congruent	789	828	925	906
incongruent	920	894	986	1039

Fig 2 Auditory stimuli followed visual ones in 100 ms (+100 ms)

Fig 1 and Fig.2 shows the average reaction times in each condition which is involoved in auditory stimuli preceding visual ones in 100 ms (Fig.1) and auditory stimuli following visual ones in 100 ms (Fig. 2). When both auditory stimuli and reaction were in both the native language (CC), the reaction time (RT) is lower than the other situation. In contrast with it, when the auditory stimuli and the reaction were both in the foreign language (JJ), the reaction time was highest. We caliculated the average reaction times in four combinations between two SOA conditions (Table 1).

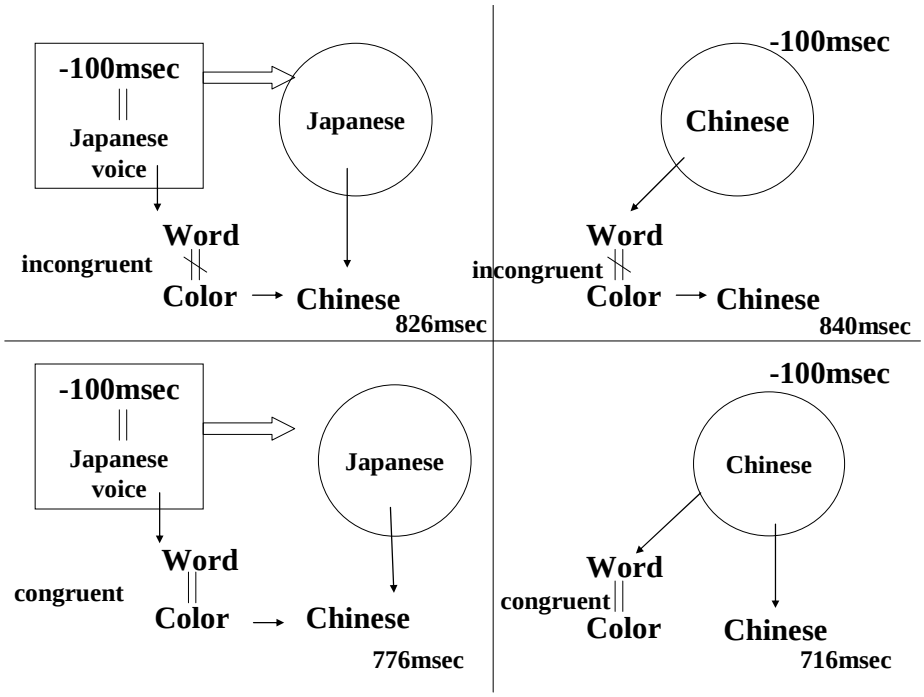


Fig 3. Reaction time in Chinese vocal reaction in SOA -100 ms.

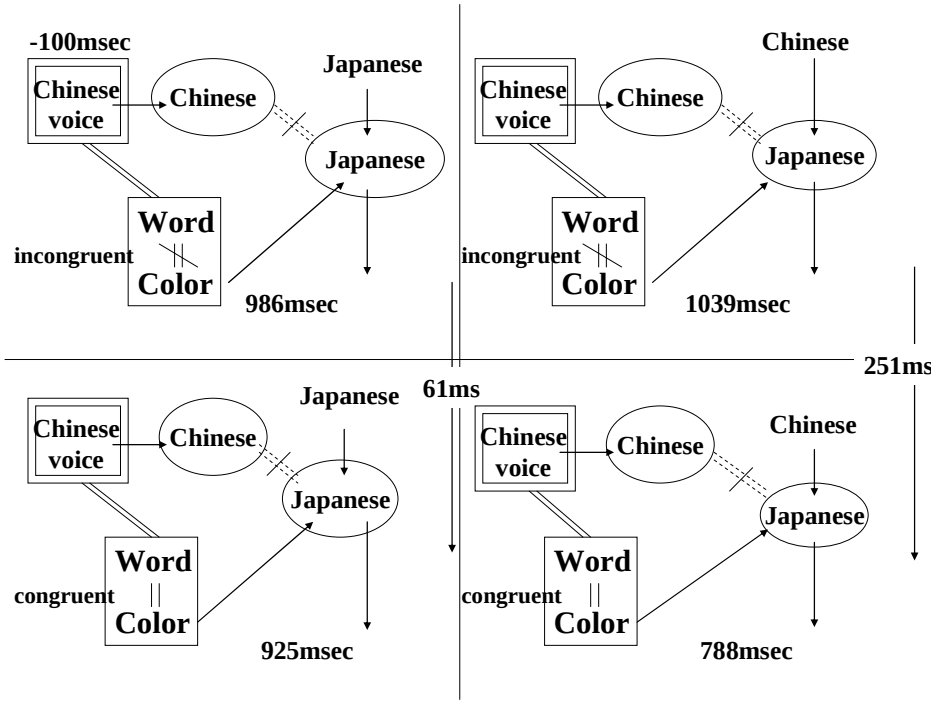


Fig.4 Reaction time in Japanese vocal reaction in SOA 100 ms

Table 1 The average reaction times in four combinations between two SOA conditions

	CC	JC	CJ	JJ
Congruent	752.5	802	925.5	929.5
Incongruent	880	860	995.5	1070

Note: C = Chinese, J=Japanese, The First Chracter=Auditory Stimuli , and The Second Character=Response

Vocal response in native language (Chinese)

When subjects made vocal reaction in Chinese, and concurrently when the auditory words in native language (Chinese) also occured, reaction time (RT) to the incongruent color-words was 127.5 msec slower than RT to the congruent one. When subjects made vocal reaction in Chinese, and concurrently when the auditory words in foreign language (Japanese) occured, reaction time (RT) to the incongruent color-words was 58 msec slower than RT to the congruent one. Vocal response in native language suffered from auditory stimuli in native language more than from auditory ones in foreign language.

Vocal response in foreign language (Japanese)

When subjects made vocal reaction in foreign language (Japanese), and concurrently when the auditory words in foreign language (Japanese) occured, reaction time (RT) to the incongruent color-words was 140.5 msec slower than RT to the congruent one. When subjects made vocal reaction in foreign language (Japanese), and concurrently when the auditory words in native language (Chinese) occured, reaction time (RT) to the incongruent color-words was 70 msec slower than RT to the congruent one. Vocal response in foreign language suffered from auditory stimuli in native language more than from auditory ones in foreign language.

Comparison of native language shared in S-R with foreign language shared in S-R.

When subjects made vocal reaction in Chinese, and concurrently when the auditory words in native language (Chinese) also occured, reaction time (RT) to the incongruent color-words was 127.5 msec slower than RT to the congruent one. In contrast with, when subjects made vocal reaction in foreign language (Japanese), and concurrently when the auditory words in foreign language (Japanese) occured, reaction time (RT) to the incongruent color-words was 140.5 msec slower than RT to the congruent one. Foreign language shared in auditory stimuli and vocal response suffered from auditory stimuli in native language more than from native language shared in auditory stimuli and vocal response.

Comparison of direction of influence between two languages; From native to foreign language vs. from foreign to native language

When the auditory words in native language (Chinese) occured, and concurrently when subjects made vocal reaction in foreign language (Japanese), reaction time (RT) to the incongruent color-words was 70 msec slower than RT to the congruent one. In contast with it, when the auditory words in foreign language (Japanese) occured, and concurrently when subjects made vocal reaction in native language (Chinese), reaction time (RT) to the incongruent color-words was 58 msec slower than RT to the congruent one. It is suggested that the pass way from the native language (Chinese) to the foreign language (Japanese) be more accessible than the opposite direction.

References

Hiroyuki SHIMADA, Noriaki TSUTSUMI, and Qiuyu LIN(2006) Effect of auditory presentation of words on the bilingual Stroop effect between Chinese and Japanese. *Proceedings of the 4th meeting of Japanese Cognitive Psychological Association.*